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REMARKS

The application has been reviewed in light of the final Office Action dated July 30, 2007. Claims 1-12, 14-16 and 19 are pending, with claims 13, 17 and 18 having been canceled, without prejudice or disclaimer. By this Amendment, claims 1 and 11 have been amended to clarify the claimed subject matter (more specifically, the real time aspect of the invention, as discussed in the amendment filed May 8, 2007). Accordingly, claims 1-12, 14-16 and 19 are presented for reconsideration, with claims 1 and 11 being in independent form.

Claims 1-7, 11, 12, 14 and 15 were rejected under 35 U.S.C. § 103(a) as purportedly unpatentable over U.S. Patent No. 6,559,643 to Miyoshi in view of U.S. Patent No. 6,483,305 to Miyamoto. Claim 8 was rejected under 35 U.S.C. § 103(a) as purportedly unpatentable over Miyoshi in view of Miyamoto and further in view of U.S. Patent No. 6,392,411 to Goto. Claim 16 was rejected under 35 U.S.C. § 103(a) as purportedly unpatentable over Miyoshi in view of Miyamoto and further in view of U.S. Patent No. 6,867,590 to Carlini.

Applicant has carefully considered the Examiner's comments and the cited art, and respectfully submits that independent claims 1 and 11 are patentable over the cited art, for at least the following reasons.

This application relates to correction of residual magnetic field (RM) in magnetic resonance imaging. RMs are typically generated by the application of a gradient magnetic field (over a static magnetic field) which enables positional encoding in the nuclear magnetic resonance signals from the subject being imaged.

Applicant devised an improved technique for correcting a residual magnetic field wherein the calculation of the residual magnetic field is executed upon every application of the gradient magnetic field pulse in the process of executing the imaging sequence, and the residual magnetic

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field response function for calculating the residual magnetic field is updated in real time in accordance with the strength of each pulse of the applied magnetic field along with the application of the gradient magnetic field pulses, upon every application of the gradient magnetic field pulse in the process of executing the imaging sequence. Each of independent claims 1 and 11 addresses these features, as well as additional features. Additional details can be found in paragraphs [0189] through [0194] and Fig. 19 of the present application.

Miyoshi, as understood by Applicant, proposes an approach for dealing with residual magnetization caused by a previous MR imaging pulse sequence on an MR image. In the system proposed by Miyoshi, a demagnetizing gradient pulse sequence is determined and then applied prior to an MR imaging pulse sequence.

Thus, in the system proposed by Miyoshi, the demagnetizing gradient pulse sequence is not applied along with the application of the gradient magnetic field.

In addition, Miyoshi, as implicitly acknowledged in the Office Action, does not teach or suggest (a) calculating the strength of the residual magnetic field being generated by the applied gradient magnetic field, by using the residual magnetic field response function and the information of the strength of the applied gradient magnetic field, (b) updating the residual magnetic field response function in accordance with the strength of the applied gradient magnetic field along with the application of the gradient magnetic field, and (c) calculating the residual magnetic field upon every application of the gradient magnetic field pulse in the process of executing the imaging sequence by using the residual magnetic field response function updated in real time, as provided by the subject matter of claim 1 of the present application.

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Miyamoto, as understood by Applicant, proposes an approach for reducing residual magnetization caused by gradient pulses, wherein a residual magnetization reducing pulse is applied after applying a gradient pulse, and in the case of two or more successively applied gradient pulses having different polarities, the amplitude of the gradient pulse(s) is adjusted to reduce residual magnetization thereafter.

Regarding calculating an amplitude of the residual magnetization reducing pulse, Miyamoto, column 7, lines 16-20, states as follows:

... Although the amplitude of the residual magnetization reducing pulse $gy1ri_{rms}$ is basically about half the amplitude of the rewinder pulse $gy1ri$ similarly to above, it is preferred that the amplitude be determined by simulation or by experiment.

Accordingly, it is clear that in the approach proposed in Miyamoto, the residual magnetization reducing pulse is pseudo-static or predetermined.

Miyamoto neither teaches nor suggests that response characteristics of the residual magnetic field change as time progresses, and the system proposed by Miyamoto is not able to cope with such changes in the response characteristics of the residual magnetic field change.

Moreover, Miyamoto, like Miyoshi, does not teach or suggest (a) *updating the residual magnetic field response function* in accordance with the strength of the applied gradient magnetic field *along with the application of the gradient magnetic field*, and (b) *calculating the residual magnetic field upon every application of the gradient magnetic field pulse* in the process of executing the imaging sequence *by using the residual magnetic field response function updated in real time*, as provided by the subject matter of claim 1 of the present application.

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The remaining cited references were merely cited against dependent claims of the present application.

Goto, as understood by Applicant, proposes an approach for measuring phase shifts in subsequent echoes due to the influence of eddy currents and residual magnetization caused by each preceding phase encoding pulse or the like in the pulse sequence in MR imaging. Goto was cited in the Office Action as purportedly showing a curve or relationship between applied gradient magnetic field and residual magnetic field.

Carlini, as understood by Applicant, proposes an approach for compensating for eddy currents induced by the switching on and off of magnetic fields in gradient coils in an MRI apparatus. Carlini was cited in the Office Action as purportedly proposing use of correction coils for compensating for the gradient-induced eddy currents.

Applicant does not find teaching or suggestion in the cited art, however, of a magnetic resonance imaging method comprising *updating the residual magnetic field response function* in accordance with the strength of the applied gradient magnetic field *along with the application of the gradient magnetic field*, and *calculating the residual magnetic field upon every application of the gradient magnetic field pulse* in the process of executing the imaging sequence *by using the residual magnetic field response function updated in real time*, as provided by the subject matter of claim 1 of the present application.

Independent claim 11 is patentably distinct from the cited art for at least similar reasons.

Accordingly, for at least the above-stated reasons, Applicant respectfully submits that independent claims 1 and 11, and the claims depending therefrom, are patentable over the cited art.

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The Office Action indicates that claims 9 and 10 are objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. However, since independent claim 1 is submitted to be patentable over the cited art, no changes to the form of claims 9 and 10 are believed to be necessary.

In view of the remarks hereinabove, Applicant submits that the application is now in condition for allowance, and earnestly solicits the allowance of the application.

If a petition for an extension of time is required to make this response timely, this paper should be considered to be such a petition. The Patent Office is hereby authorized to charge any fees that are required in connection with this amendment and to credit any overpayment to our Deposit Account No. 03-3125.

If a telephone interview could advance the prosecution of this application, the Examiner is respectfully requested to call the undersigned attorney.

Respectfully submitted,



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